IMPROVING THE PROPERTIES OF HEAT-INDUCED WHEY PROTEIN HYDROGELS PRODUCED UNDER THE EFFECTS OF MODERATE ELECTRIC FIELDS

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INTRODUCTION

Research on whey utilization is now being largely focused on exploiting their physiochemical and bioactive properties. Whey protein isolate (WPI) is among the most important whey-derived ingredients and consists of products purified to a high protein content (> 90%). The denaturation and aggregation kinetic behavior of WPI upon heating is of particular relevance; when properly engineered and controlled, it results in the production of novel nano-structures with many potential uses in food formulations (i.e. enhancement of textural properties, action as stabilizing agents and delivery of biologically active substances). Combination of heat and moderate electric fields (MEF) treatment interferes with unfolding and aggregation pathways of whey biopolymers [1].

OBJECTIVE

The objective of this study was to induce thermal aggregation of a liquid dispersion of WPI into a three-dimensional network, a so called hydrogel, through combined application of heating and electrical treatment (MEF).

MATERIAL AND METHODS

WPI dispersions (3 % w/v and pH=3) were heated with and without presence of MEF treatments (3 and 10 V/cm) at temperatures of 90 °C. After a heating come-up-time (CUT) period (to raise the temperature from 25 ºC to 90 ºC) the treatment temperature and electric field applied were held constant (holding) for 5 min. Nanostructures and nano-scale phenomena of the initial steps of whey protein aggregation as affected by the applied electric field were assessed by nano-tracking analysis (NTA) and dynamic light scattering (DLS) techniques. Treated WPI hydrogels were analyzed under steady shear flow using a controlled stress rheometer with concentric cylinder geometry in order to assess the effects of MEF on macroscopic properties of the hydrogels produced.

RESULTS

Extent of aggregation decreased with increasing MEF intensity applied, being the onset of gel formation characterized by a polimodal distribution in all treatments; during the first 2 minutes of heating at 90 ºC, MEF treatments applied at 0, 3 and 10 V/cm have determined average mean particle sizes of 156.9 ± 10.7 nm, 141.1 ± 12.9 nm and 117.7 ± 7.8 nm, respectively. From the rheological measurements follows that hydrogel formed under high electric field shows a low apparent viscosity values at high shear rates (see Figure 1). In conclusion, MEF induces changes from a nanometer to macromolecular range thus offering a great potential to the development of WPI hydrogels with diverse mechanical and microstructual features.

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References

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